EDITORIAL ARTICLES.

REICHEL ON THE ÆTIOLOGY AND SURGICAL TREATMENT OF SEPTIC PERITONITIS.[1]

The first part of Reichel's paper consists of a critical review of former experiments upon the production of artificial peritonitis by other observers, as well as himself. He likewise refers to some experiences in gynæcological laparotomy, and the septic peritonitis following thereon, and draws certain conclusions from these, as follows:

The absence of evidences of peritoneal inflammation in those who have died after laparotomy does not necessarily combat the belief that the cause of death was due to septic intoxication. As corroboration of this it is observed that persons dying from illeus and with intestinal paralysis resulting therefrom, perish from sepsis, before the occurrence of peritonitis.

In experiments upon animals Reichel found wide and unexplainable differences in individuals in respect to the susceptibility of the animal itself, as well as to the ability of the peritoneum to absorb septic material. The important point was developed by Reichel that some animals, which in the first instance successfully resisted the deleterious effects of the infectious material introduced by the frequent introduction of these small quantities finally came to resist the larger ones, and thus an artificial immunity was established against the effects of septic material upon the peritoneum. Grawitz' assertion that fæcal matter is not necessarily infectious is combatted by Reichel, who found that its presence in the peritoneal cavity was an active source of infection; this latter being in harmony with everyday experience. Grawitz likewise advances the belief that the peritoneal inflammation is most frequently due to the removal of large patches of peritoneum; but Reichel in his experiments shows that large portions thus removed do not give rise to peritonitis necessarily.

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[1] *Deutsche Zeitschrift f. Chirurgie*, bd. xxx, p. 1–84.

Reichel's studies upon septic peritonitis following laparotomy are based upon 174 cases occurring at the Berlin Gynæcological Clinic. In general, as he shows, the simpler and more uncomplicated the operative procedure the more uninterrupted the course to recovery, and the better the prognosis. Abdominal ascites, or the presence of fluid which has escaped from cysts in the peritoneal cavity, is an unfortunate complication, at least 22% of the fatal cases dying from sepsis arising from this cause. Explorative incision in those cases which proved to be malignant seems to have been a not dangerless procedure, 20% dying from infection following its performance. Peritonitis arising from twisting of the pedicle of an ovarian cystoma does not necessarily give rise to sepsis nor increase the danger thereto, save as it gives rise to a larger number of adhesions and increases thereby the amount of wound surface exposed by the operation. The belief of Kümmel that, even in the most carefully conducted antiseptic laparotomy, germs will find their entrance into the peritoneal cavity, is supported by Reichel. The explanation of the immunity from sepsis which these patients enjoy is to be found in the rapidity with which the effused peritoneal fluids, with the germs, are taken up by the serous membranes and transferred to the blood current, from which latter they are readily eliminated. The most important conditions favoring the occurrence of septic peritonitis are stated as follows :

1. The occurrence of large quantities of fluid in the peritoneal cavity which it is beyond the power of the serous surfaces to resorb, or the constant renewal of the supply of pathogenic germs in the abdominal cavity.

2. The arrest of putrefactive material in dead spaces.

3. A disturbance of the powers of resorption of the serous membrane as well as an increase of transudation from its surface. (Ascites, carcinoma, etc.)

Prophylaxis, antisepsis and asepsis, in view of the exceedingly unfavorable prognosis, must be the main reliance in septic peritonitis.

The method of Mikulicz of packing iodoform gauze into the peritoneal cavity is objected to by the author on account of the danger to be apprehended from iodoform poisoning, as well as those which may arise from removal of the gauze. The fear of favoring ventral hernia by this method is also considered. Stress is laid upon the necessity of operating early following a non-septic peritonitis should the case require laparotomy, in order to avoid the increased dangers arising from the presence of extension and dense adhesions.

Experimental attempts to successfully treat septic peritonitis, artificially produced in animals were almost entirely without success. Irrigation of the peritoneal cavity with sublimate, chloroborate of soda, salicylic acid, etc., were useless; the animals quickly perished. Laparotomy performed after the introduction of fæcal matter, for the purpose of cleansing the peritoneal cavity, and prior to the development of peritonitis, resulted in the same manner. Irrigation, according to Reichel, is not only useless but, even in healthy animals, proved to be an injurious measure. Somewhat better results were obtained by sponging gently the peritoneal surfaces, after opening the abdominal cavity, with bunches ot gauze, and employing the gauze in drains of Mikulicz. In 9 experimental cases in dogs, 2 recoveries were obtained by this means.

The author is extremely skeptical concerning the value of the so-called surgical treatment of peritonitis. The only conditions in which it is at all likely to be of service is in the empyæma-like, or encapsulated septic peritonitis arising from intestinal perforation, in which there exists an early opportunity of cleansing the cavity and closing the perforation. These views are in accord with the experiences of surgeons of the present day, particularly in gunshot and stab wounds of the peritoneum, in which the tendency to early interference is becoming more and more marked.

GEORGE R. FOWLER.

STEINHAUS ON THE ETIOLOGY OF ACUTE SUPPURATIONS.

It has long been a matter of absorbing scientific interest to the pathologist as well as of practical importance to the surgeon, to investigate the direct causes of every kind of suppuration, and the views generally held on this subject have from time to time undergone various changes. Readers of the ANNALS will remember how, after the experiments of Uskoff, Orthmann and Councilman, the theory that there could be suppuration present in the living tissues without the presence of micro-organisms was very generally accepted, but that, after other experimenters (Scheuerlen, Klemperer) had similarly repeated these investigations, the general opinion was in favor of excluding suppuration from any other cause but from the action of bacteria.[1] These experiments have continued since that time, until we have at the present date an immense amount of material amassed, dealing only with this subject, but giving in great part the most contradictory evidence, and requiring for its review alone a great expenditure of time and labor.

Quite recently Dr. Steinhaus, assistant at the pathological laboratory of the University of Warsaw, has undertaken this task. But not only has he given us, in the form of a pamphlet published in Germany[2] a complete critical review of the literature of the subject under consideration up to date; he has also taken the trouble of repeating all the experiments hitherto described with a view to confirming or disproving them, and has thus added the results of some 300 experiments of his own to his work. We give a short abstract of his work in the following pages.

To begin with, the methods employed by the author in his experiments deserve attention, since with their approbation his results must stand or fall.

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[1] ANNALS OF SURGERY, Vol. 3, 507. 1886.

[2] Julius Steinhaus, Die Ætiologie der Acuten Eiterungen. Leipzig, Veit und Comp. 1889. New York, G. E. Stechert.

The sterilisation of the substances injected beneath the skin of animals was done with Koch's apparatus. For injecting, the syringes composed of glass and metal were boiled for one or two hours in a 3 or 5 % carbolic solution, and well rinsed out in sterilised water. Very long needles were used, so that none of the injected fluid might come into contact with or in any way influence the puncture-wound, since we know that the injected focus is frequently contaminated by infections from without, which may travel along the puncture-canal.

Strauss' method was also used to inject fluids under the skin, which consists in first cauterising an area of the skin, in order to render it aseptic, then introducing the pointed end of a thin glass tube into the tissues through the cauterised area, breaking off the point subcutaneously, expelling the liquid into the tissues, withdrawing the tube, and finally again cauterising the punctured wound.

The only drawback connected with this method of Strauss' is the fact that the cauterisation so largely promotes absorption that frequently no reaction whatever results.

The method of Cohnheim and Councilman was also used; in which cases little glass tubes filled with the various fluids were introduced into the subcutaneous tissue in the sacral region,and pushed along under the skin, to the cervical region, where they were broken after the first wound had healed; care being taken to move them once again just before breaking in order to avoid any encapsulations by connective tissue, which might have occurred.

Antiseptic precautions were of course taken throughout, the dressings usually consisting of a thick coating of iodoformised collodion.

Even after injection of pure cultures of various micro-organisms similar precautions were taken. Proper precautions, which are not, however, given in detail, were also observed during the post-mortem examination.

The cultures were raised on soils in accordance with Koch's methods; but the author also frequently used the extract of cibil instead of meat extract in their composition.

The cover-glass specimens used for examination of these cultures, as well as of the fluids of the body investigated, were not prepared by heat: The bacteria and cells were affixed to the cover-glasses by soaking them for an hour or two in a concentrated aqueous solution of sublimate. The coloring was generally done with hæmatoxylin and safranin.

We turn now to the consideration of the various substances experimented with by this conscientious worker.

Mechanical injuries to the tissues never resulted in suppuration unless bacteria were admitted. Foreign bodies made sterile, before introduction never caused suppuration.

Of inorganic chemical substances *water* was the first experimented with; distilled and sterilised it never produced suppuration when injected beneath the skin of rabbits, dogs, guinea-pigs, or cats. These results corroborate Orthmann's statements and those of Wegner. They are at variance with those of Ushoff, whose methods of sterilisation were probably insufficient.

Chloride of Soda in ½ % solution was likewise readily absorbed by all four classes of animals, and without suppuration; which tallies with the results of Wegner and Councilman.

Chloride of zinc in 2 % solution subcutaneously injected in rabbits and cats produced necrosis of the fascia, the subcutaneous tissue, and the deep layers of the skin, without inflammation or suppuration. These results are compatible with those obtained by Rausche and Christmas; although in some cases where the injection was done more superficially and where the necrotic portions became exposed to the air, suppuration was observed by these experimenters. Grawitz and de Bary, however, traced this suppuration to the action of the micro-organisms contained in the air.

Sublimate was injected in 2% solution and in quantities of one cubic centimetre (♏xvj.) and was absorbed without reaction in dogs, cats, rabbits and guinea pigs. If, therefore, injections of this substance frequently causes abscesses in its clinical use, as in syphilis, this is because infection takes place through the puncture-wound. Grawitz and de Bary also experimented with sublimate and got similar results.

Calomel injected subcutaneously in rabbits, cats and dogs produced suppuration without bacteria, an identical result with that obtained by Chotzen and by Mazza. This pus showed degenerative features, most of the cells containing only the nucleus, round, oval, or oblong in shape, and hard to stain.

Mercury introduced in small globules under the skin of rabbits and guinea-pigs becomes incapsulated without suppuration. Small glass tubes containing mercury are blocked at the ends by a mass of pus-corpuscles without micro-organisms.

In dogs and cats a good deal of pus was found about the mercury, which had oozed out of the tubes, but this pus was free from bacteria.

These results are not incompatible with the large number of seemingly opposed results in experiments already published by Biedel, Orthmann, Strauss, Brewing, Klemperer, Zuckermann, Christmas and Rosenbach.

Only Riedel and Christmas obtained suppuration in rabbits, and then by injecting the mercury into serous cavities and the anterior chamber of the eye, respectively.

Nitrate of silver was used in solution of various strengths. In rabbits a 1% solution produced necrosis below the skin, but a 5% solution destroyed the entire skin. In one case only an ulcer formed after the sloughing process, secreting pus, which contained staphylococci. In dogs 5% solutions produced suppuration containing no micro-organisms.

In guinea-pigs 2% solutions produced sero-fibrinous inflammation in which no bacteria could be found; 4% solutions had the same effect as on rabbits.

Cats showed extensive phlegmonous conditions and suppuration without bacteria both after injections with 1% and with 5% solutions. The pus contained a great many cells with one nucleus which showed much affinity to the safranin stain. Dembczak, Grawitz and de Bary, Brewing, Christmas, Nathan all made similar experiments which do not vary in their results from the above, although the authors differ in their explanations.

Sulphate of magnesia did not produce suppuration in rabbits and guinea-pigs---a result identical with that of Scheuerlen.

Ammonia (liquor ammonii caustici) did not cause suppuration. Diluted with 4 parts of water as much as $\frac{1}{2}$ a cubic centimetre (♏viij.) was absorbed in rabbits without reaction. In guinea-pigs, however, even $^1/_5$ of a cubic centimetre (♏iij.) produced necrosis of the tissues; a similar result was noticed in dogs after the injection of ♏ xvj., and in cats after ♏viij.

Zuckermann's and Brewing's results correspond with the above; and although Grawitz and de Bary observed abscesses without bacteria in dogs, yet Nathan, on repeating these experiments, found either absorption (after ♏xvi) or necrosis (after ♏xxx to lx.) without suppuration—a result corresponding to that of the author's.

Oil of turpentine produced suppuration when injected into the tissues in dogs and cats, and no micro organisms could be discovered with the microscope or with culture experiments.

In guinea pigs as much as ♏ viij. was absorbed without inflammatory reaction, and in rabbits either absorption or temporary inflammatory œdema or sero-fibrinous inflammation without bacteria was produced according to the quantities used.

The results obtained by Uskoff, Orthmann, Klemperer, Krauzfeld, Scheuerlen, Rujis, Biondi, Zuckermann, Grawitz and de Bary, Mosso, Christmas, Nathan are in accordance with the above. As regards opposing statements, we find that Brewing and Passet did obtain suppuration with turpentine in rabbits, but it must be remembered that they allowed the glass tubes containing the oil to become encapsulated before fracturing them, and that, therefore, these conditions are not identical. Karlinski observed absorption of the oil in dogs without suppuration, but he made extensive use of the thermo-cautery, which may explain the more rapid absorption without reaction.

Croton oil, when diluted 1 part in 4 with olive oil and injected in rabbits and guinea-pigs, produced necrosis of the skin; when introduced pure, enclosed in glass tubes, in rabbits and dogs, the tubes were encapsulated without suppuration. Leucocytes were present in quantities, but none inside the tubes, having probably been destroyed there by the oil.

Strauss, Klemperer, Scheuerlen, Rujis, Zuckermann, Grawitz, de Bary, Christmas, all agree with the above in their results, while Gussenbauer, Ogston, Councilman, Passet are at variance.

Antipyrin in 50% sterilized solution injected subcutaneously in quantities from ♏ viij. to ♏xvi. failed to produce inflammatory reaction in rabbits, cats, pigs and dogs.

This result is in direct contradiction to the experiments of Frick.

Carbolic acid injected as a 3% solution in doses of ♏ xvi did not produce inflammatory reaction in cats, rabbits or dogs. Riedel and Gussenbauer had arrived at different conclusions.

Petroleum produces suppuration without micro-organisms in dogs and cats, but merely sero-fibrinous inflammation in rabbits, a result which corresponds with the experiments of Klemperer, Rijis and Christmas, although it does not agree with the deductions then made from them.

Suanidin, a substance closely related to urea, was inserted in a 10% aqueous solution under the skin of dogs, cats and rabbits; encapsulation ensued without suppuration. This substance had never before been experimented with.

Milk, sterilized and injected in quantities ranging up to ♏xxx, was absorbed without reaction in rabbits, cats and dogs.

This corresponds with Orthmann's experiments—the contrary experience of Samuel and Uskoff being rejected as due to unreliable methods.

Pure cultures of *staphylococcus pyogenes aureus*, after having been allowed to develop for sixteen days at 24° C. were first killed and then subcutaneously injected in dogs in quantities of ♏xvj, and produced abscesses free from bacteria. In cats, twice the amount was injected after having been evaporated down to half its volume, and also produced abscesses. In rabbits these quantities were rapidly absorbed. Tubes, however, filled with the cultures, produced small quantities of pure pus without bacteria, which plugged the ends of the tubes. This experience corresponds with the assertions of Pasteur, Scheuerlen, Grawitz, de Bary, Karlinski, Christmas—while Leber and Christmas succeeded in getting suppuration by extracts from the cultures—the one a crystalline product, the other an albuminoid. Microscopically the pus thus produced in no way differed from that caused by bacteria.

Dead cultures of *bacillus prodigiosus* used in the same manner produced sterile abscesses in dogs and cats and were absorbed in rabbits; except when introduced in glass tubes. In this case pus formed and plugged the openings.

Grawitz and Bary obtained similar results when the culture was made on agar-agar; but when made on blood-serum soils no inflammation followed. Wyssokowitsch also proved the pyogenic nature of the germ for rabbits.

Bacillus pyocyaneus, the bacillus of blue or green pus, in inspissated and sterilized cultures, produced abscesses without bacteria in cats after subcutaneous injection. Injections of ♏xvj in dogs, guinea-pigs and rabbits, were absorbed without reaction; but on introducing the glass tubes, pus could be traced at the ends of the tubes.

Ledderhose, repeating some experiments of Ernst, had also found suppuration without bacteria, in some cases where he had used this micro-organism.

Bacillus anthracis, cultivated in gelatine and sterilized, was absorbed in quantities of ♏xvj in rabbits and cats without inflammation when injected under the skin. Introduced in glass tubes, however, it caused pus to form in small quantities. These results are somewhat at variance with Wyssokowitsch's deductions.

Live *stapyhlococcus pyogenes aureus* and albus in suspension in salt solution (0,6%) in quantities ranging from half to one cubic centimeter (♏viii to xvi) produced no abscesses in rabbits, but were absorbed without infection; also when gelatine-cultures were used which had stood for sixteen days. Intra-peritoneal injections had similar results. Dogs, cats and guinea-pigs, however, were locally infected by these injections, abscesses resulting containing the germs. Mice were not influenced. Rabbits were not infected even when a suspension in grape-sugar solution was used (contrary to Bujvid's results). Grawitz and de Bary and Fehllisen had shown before, that small quantities of these micro-organisms injected with proper precautions so as to exclude infection from without, did not always cause abscesses.

Bacillus prodigiosus, injected subcutaneously in gelatine culture to the amount of ♏xiij produced abscesses in rabbits, cats and dogs; and peritonitis with metastatic abscesses when injected intra-peritoneally in rabbits. These results tally with those of Grawitz and de Bary and Wyssokowitsch.

Bacillus pyocyaneus always caused abscesses in dogs and cats; but in rabbits the same amount (♏xvj) of a gelatine culture produced only sero fibrinous inflammation, while twice the amount produced abscesses. In guinea-pigs ♏viij produced sero-fibrinous inflammation only. Gruber and Ledderhose obtained somewhat similar results.

We see from the foregoing, that so far as our present knowledge is to be relied upon, we are justified in believing that suppuration in the living tissues is the result of some certain chemical action, which may be combined with the presence of bacteria, or may be obtained from pure chemical substances without the presence of micro-organisms. Whether this conclusion is of any great practical interest, or whether the remarks of Weigert and Councilman will still exert their influence, attributing to them a merely theoretical interest, remains to be seen; these gentlemen pointed out, that although in experiments, chemical substances may produce suppuration, yet, clinically, at the bedside, all suppuration met with was due to the action of micro organisms. This questions appears of special interest in regard to cold abscesses, the pathology of which still appears to be considered unsettled by many. The great merit of the work of Steinhaus lies in the fact, that he demonstrates that the action of the same micro-organisms varies greatly in different animals; and by this means he is able to unite a great number of apparently opposite experimental results.

In conclusion the author gives the results of his investigations of 49 clinical cases of suppuration—4 of chronic and 45 of acute abscesses and phlegmons. He comes to the conclusions that Rosenbach's view of the etiology of these abscesses is no longer tenable. This writer believed that the staphylococcus produced phlegmons more frequently, and the staphylococcus abscesses. But the present author found both as causing either; the staphylococcus in 66, the streptococcus in 20% of the cases; and both in 9%. In three of the chronic cases no micro-organisms were found. W. W. VAN ARSDALE.